idea of the change which has taken place. Some constituents are readily removed; others, especially the alumina, are comparatively insoluble under ordinary conditions, and therefore remain behind. Thus, Columns III., IV. and V. show the loss or gain of the various constituents estimated on the basis of constant alumina. We may remark, in passing, that alumina may be removed under certain conditions; as, for example, when sulphuric acid is formed by the oxidation of pyrites. This shows the necessity of caution in taking alumina as the basis of comparison, but it does not affect the present case. From Column III. we learn that 31 per cent. of silica, 1·3 of ferric oxide, the whole of the lime, and the greater part of the magnesia and alkalies have been removed. The total loss amounts to 44 per cent. In this case, the breaking down of the rock has been accompanied by decomposition as well as disintegration; in other cases decomposition is not so prominent, and the total loss is consequently much less.

Many rocks are treated in the same way, but one other illustration must suffice, and for the complete data in this case we must refer the reader to the book itself. In certain parts of America, and indeed in all countries where limestones are extensively developed, and where the residual products of decomposition are allowed to accumulate for a considerable length of time, a superficial deposit of red or brown clay is formed. In these cases the author considers that silica may be assumed to be constant, and taken as the basis for calculating the amount of material removed. He thus arrives at the conclusion that in the particular case described by him 97 per cent. of the original limestone has disappeared. In some localities residual clays of this kind attain a thickness of from 20 to 120 feet.

Having considered in detail a number of special cases in the manner above described, the author proceeds to deal with the influence of joints of texture, of mineralogical composition, of climate, and many other factors. All these points are discussed in the light of recent knowledge, and the chapters devoted to them are full of interesting and important information. Illustrative cases are mostly drawn from American sources, and this gives to the book a refreshing novelty, at any rate to English readers, even when well-known principles are treated. Especially interesting are those portions dealing with climate. It is pointed out that in cold and dry climates, subject to extremes of temperature, disintegration is the dominant factor; whereas in moist, warm climates decomposition is very pronounced. Thus the careful study of the petrographical character of sediments may be expected to throw important light on the climatic conditions of those regions which furnished the material. This point is, of course, not new; but its importance has not been fully recognised, and it is therefore satisfactory to see that the author gives it a prominent place.

The concluding part of the book deals with the superficial deposits for which the term regolith is proposed. Under this term is included not only the soil, subsoil and residual products of decomposition, but also the alluvial, æolian, and glacial deposits. We are by no means convinced that the author was well advised in departing from his general and most praiseworthy determination to avoid as much as possible the introduction of new terms; but the point is, after all, of comparatively slight importance. If the term supplies a want, it will come into general use; if not, it will die out.

The petrographical characters and conditions of formation of the various deposits classed as the regolith are described, and we are glad to see that special attention is paid to the æolian formations, as these often receive scant courtesy at the hands of geologists. Loess, however, is discussed under alluvial deposits, although it is ascribed in part to the action of the wind. Surely there can be no doubt that typical loess is of æolian origin; and if, in America or elsewhere, alluvial deposits have been included under this term, this should be recognised as a mistake, and speedily rectified.

The work is admirably illustrated by twenty-five plates and numerous figures in the text, all of which have been produced in the manner so highly appreciated by those who are acquainted with American geological literature.

MECHANISM AND BIOLOGY.

Zeit- und Streitfragen der Biologie. Heft 2. *Mechanik und Biologie.* Von Prof. Dr. Oscar Hertwig. Pp. iv + 211. (Jena: Gustav Fischer, 1897.)

FROM the title of this work one might have expected a critical examination of the validity of the general principles of modern biology, more particularly of modern physiology; and such a criticism, from the pen of Dr. Oscar Hertwig, would have been welcome and instructive. It is with a feeling of disappointment that one finds that his criticism is almost entirely confined to a comparatively limited aspect of the question, and is, in fact, a polemical treatise directed especially against the pretensions and conclusions of Wilhelm Roux and his school. It is, no doubt, a simpler task to refute the theories of Roux; but if Dr. Oscar Hertwig is victorious in this particular argument, it must not be supposed that he has weakened, or that he has even attempted to weaken, the conviction held by the majority of biologists, that the explanation of vital processes is to be sought for on "mechanical" principles. There is, however, a considerable amount of obscurity attached to this word "mechanical" as applied to biological phenomena, and many pages of this book are devoted to pointing out the errors into which we may be led if we use the word in a loose and general sense, or if we confuse its philosophical with its physical meaning. In its widest sense a mechanism is a system of objects, which in place and time stand in a necessary relation to one another. Hence, when we describe the attitude of contemporary science as mechanical, we do but assert that science is convinced that the operations of nature are subject to the control of universal law. Of this the biological are as much convinced as the abiological sciences; yet this conviction does not necessarily lead to the conclusion that the methods of the abiological are in all respects applicable to the biological sciences. To discuss this question is to discuss the philosophical basis not only of biology, but of all the sciences. As a contribution to the discussion, Dr. Hertwig gives us copious quotations from Spinoza, Kant, Lotze and other philosophers, skilfully selecting such passages from these thinkers as best serve his immediate purpose of refuting Roux. His readers would have profited had he taken a more detached view of his subject, and had attempted to define the grounds of our belief in the prevalence of universal law in biological phenomena without special regard to Roux or any other author.

In the second part of this book, Dr. Hertwig deals with the methods of developmental mechanics as put forth by Roux and his school. Roux is one of those who specially represents a modern tendency to magnify the importance of experiment in biological investigation, and to minimise the value of what is called "mere observation." It has been pointed out, over and over again, that there is no sharp distinction between experiment and observation, hat some of the most complete, the most "mechanical" of the sciences—as, for example, astronomy—are, from the nature of things, sciences of observation, and that what we call experiment is but a means to an end, the end in every case being observation of the change of state following the disturbance which was the first step introduced by the experiment. Here, says Dr. Hertwig, there is a great difference between the inorganic and the organic world. Inorganic substances are relatively stable; the simple contemplation of them would lead to no result. It is only by disturbing their condition of equilibrium, by causing changes of state in them, that we can observe a succession of phenomena which will enable us to assert relations of cause and effect. With living things the case is different; they are in a constant state of flux, and observation presents us with an unbroken succession of changes whose laws may be traced by the aid of reflection. What is true of biology in general is especially true of the study of the development of organisms, since it is during their development that organisms exhibit the most numerous, the most constant, and the most unbroken succession of changes. In depreciating the results of observation, and in drawing a brilliant picture of the results which are to follow from the use of experiment in biology, Roux, and those who, like Yves Delage, have followed him, have fallen into the error of supposing that observation is necessarily an act of contemplation without reflection, and that reflection added to observation raises the last-named to a level which has neither been attained nor sought after by the majority of workers. Such an error is easily refuted by Dr. Hertwig, who shows that in the domain of embryology the method of observation has been strikingly fruitful of results; that embryologists have been distinguished for the readiness, sometimes by the over-eagerness, with which they have drawn conclusions as to cause and effect from the results of their observations; and, finally, that the much-praised method of experiment, when applied to embryological research, has been comparatively barren of result. We have, indeed, learnt some new and striking facts from the experiments of Driesch, Wilson, Zoja, and of Hertwig and Roux themselves; but the main result of these experiments has been to overthrow the speculations of the school which plumes itself on its insight into the mechanical processes of development.

To most persons the most interesting part of Dr. O. Hertwig's book will be the appendix, which contains critical observations on the mechanical laws of development promulgated by Roux. This author, it will be remembered, as a result of experiments and observations, made by him on the developing ova of the frog, formulated a series of developmental laws, of which the chief were: that the plane of the first segmentation coincides with the sagittal plane of the future embryo; that the four first blastomeres correspond to four definite regions, right and left anterior and right and left posterior of the future embryo; and so forth. From these so-called laws theoretical conclusions of wide applications have been drawn. It has been asserted that the organs and tissues of the adult are represented by equivalent ultramicroscopical particles in the ovum, and that these particles are distributed in the ovum in a manner corresponding to their prospective situation in the adult. The particular manner in which these hypothetical particles give rise, in the course of development, to the tissues and organs of the adult, is set forth in Roux's theories of self-differentiation and mosaic-work. Dr. Oscar Hertwig deals in detail with the developmental laws of Roux and their consequences, and shows that, in the first place, the laws have no validity, and that, therefore, in the second place, the conclusions drawn from them are without foundation. Roux destroyed one of the first two or four blastomeres of the frog's ovum, and stated that the embryo resulting from the development of the remaining blastomere or blastomeres was a half embryo or quarter embryo, deficient in those parts which were contained in the blastomeres which had been destroyed. Hertwig, repeating the same experiments, showed that destruction of any of the earliest blastomeres does not, in fact, lead to the results which were described by Roux, and that the early blastomeres might be, so to speak, shuffled up by means of pressure, and yet a perfectly normal embryo be formed. Hertwig's experiments are confirmed by those of Driesch, Wilson and Zoja, who have shown that if the first four blastomeres of echinoderms, of amphioxus, or of hydromedusæ are separated from one another, each gives rise to an embryo, normal in all respects, except that it is a quarter of the usual size. Such experiments point conclusively to the fact that the material of the egg is not qualitatively, but quantitatively divided in the first stages of segmentation, and that Roux's theories of mosaic-work and self-differentiation are, therefore, without foundation. In the appendix to this book the experiments and conclusions of Roux, and the conflicting observations of Hertwig, Driesch and others, are given in a concise and easily intelligible form; and the reader will hardly fail to be persuaded that the balance of evidence is in favour of Hertwig's opinion. At the same time, it must not be forgotten that there is a considerable mass of evidence in favour of Roux's main proposition, that in *normal* development the first segmentation planes do mark out particular regions of the future embryo. Dr. Hertwig has handled Roux somewhat severely for his definitions of normal and abnormal development; but the truth seems to be this. That the ovum of any animal, if left to itself, will go through a course of development which may be called normal, of which one of the features is that the symmetry of the adult is expressed by the earliest cleavage planes. But this course of development, though normal, is not *necessary*. If the blastomeres be displaced, or even if they be separated, development will complete itself, and the end result is the same, though the first steps have been different. The conclusion is that developing organisms, like adults, are possessed of considerable powers of adaptability. Exposed, for the most part, to very similar conditions, they develop in a very similar way, which we come to recognise as the normal way. But, if the conditions are varied within certain limits, the developing organism adapts itself to those changes, and completes the cycle of its existence. All the evidence, whether from the side of Roux, or from that of Hertwig, Driesch and others of the same opinions, shows that there is a very definite limit to the disturbances to which the developing ovum is capable of adapting itself. Such discussions as are contained in this book only serve to bring forward more prominently the view that the organism is the result of the interaction between its own specific nature and the environmen It would seem that the next essential step in biological inquiry is to determine in special instances what is the nature of the reaction of living substance to external conditions. Much has been attempted in this direction, but the results have hitherto been indefinite, and even contradictory.

THE EXAMINATION OF THE BLOOD IN DISEASE.

A Guide to the Clinical Examination of the Blood for Diagnostic Purposes. By Richard C. Cabot, M.D. With coloured plates and engravings. Pp. xix + 405. (London, New York, and Bombay: Longmans, Green, and Co., 1897.)

SINCE Hughes Bennett's observations on leucocythemia were recorded, great advances have been made in the methods of examining blood, and a certain limited number of physicians, appreciating the importance of the changes that take place in the blood as indicative of changes in the more fixed tissues, have laid considerable stress on the necessity of determining the exact constitution of the blood in certain forms of disease. With all this, however, the use of the various apparatus devised for such estimations have never come into general use. For this there appear to have been two principal reasons: (1) that the medical man has not considered that the information to be derived from such examination is at all commensurate with the time and skill required to obtain such information; (2) the second reason, which, however, is intimately bound up with the first, is that hitherto we, in this country at any rate, have been beholden for any systematic account of the pathology and clinical pathology of the blood to Hayem in France, and to Grawitz, Schmaltz and Rieder in Germany, as up to the present there has been no systematic treatise in the English language on the clinical examination of the blood. Indeed, in recent years, although much valuable work on the blood of animals artificially treated has been published by a number of our younger physiologists and pathologists, and although Gower's work has formed the basis of much of the clinical examination that has been done, it is to the impetus that Metchnikoff and Ehrlich have given to the study of the blood as a histological tissue that these advances have been made. A similar impulse seems to have been given in America, with the result that there has come from the Johns Hopkins Laboratories a work which, whilst based on the researches carried out in France and Germany, has nevertheless a certain individuality and value quite apart from that reflected in it from foreign workers. Dr. Cabot, approaching the subject from the point of view of a man who has made himself thoroughly familiar with the various methods of examining blood, having already examined the blood from nearly a thousand cases, and has at his command the observations on about three thousand more cases examined in the Massachusetts Hospital, gives an account of the structure of the blood, in which, however, it is evident that Ehrlich's observations have been made the basis of the descriptions, as outside Ehrlich's classification the accounts of the structure and appearance of the corpuscles are somewhat meagre, especially from the purely clinical point of view. In the accounts of the systematic work this is, perhaps, not altogether a disadvantage; still we think that those who come to compare this work with the results that they may obtain, either in clinical or in experimental work, will find that full use has not been made of more recent investigations, especially those that have been carried on in this country.

It is impossible, in a short review, to give more than a very meagre outline of this work; but, as it is really the first of its kind that has appeared in the English language, it may be well to indicate the enormous amount of matter that has been collected and arranged in handy form for reference. In the first instance, the methods of clinical examination of the blood are set forth, and from the completeness and accuracy of the descriptions given, and from the fact that the author is so frequently able to indicate the difficulties met with, and the methods of getting over them, it is evident that he has a thorough practical acquaintance with his work. We are glad to see that he insists very strongly upon the examination of the fresh blood—a method of examination which is far too little used in these investigations. The instruments recommended are all of German origin, and the difficulty that has hitherto been found by those working with these instruments are acknowledged. What strikes one very forcibly in this connection is the value of the "Tintometer" system as compared with any of those here mentioned. In describing the myelocytes—the non-motile marrow cells with their large, simple nuclei—Dr. Cabot appears to assign to mere mechanical conditions the regularity of the nucleus, and he says that "the absence of amœboid motion, and of journeys through tissues, leaves the nucleus evenly and moderately stainable throughout, while the amœboid blood leucocyte, through the wear and tear of its migrations, gets its chromatin irregularly distributed, condensed here, pulled out thin there, and hence stains unevenly or is mottled." This point is referred to on several occasions throughout the book. Surely the want of amœboid motion is indicative of the inactivity of the cell, the regularity of the nucleus pointing to the fact that it is in the so-called resting-stage, especially as it is indicated that marked degenerative changes may be observed in these myelocytes. We should feel strongly inclined to reverse Dr. Cabot's cause and effect. After an account of the methods of clinical examination and the physiology of the blood, several chapters are devoted to the general pathology of the blood, after which the bulk of the book is devoted to the special pathology of the blood, primary anæmias, leuk-